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Bates et al.

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(54) **AUTOMATED SELECTION OF AUDIO BROADCAST SIGNAL SOURCE BASED ON USER PREFERENCE CRITERION**

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(52) **U.S. Cl.** **455/553.1**; 455/161.1; 455/161.2; 455/186.1; 455/186.2

(58) **Field of Search** 455/186.1, 553.1, 455/161.2, 161.1, 186.2

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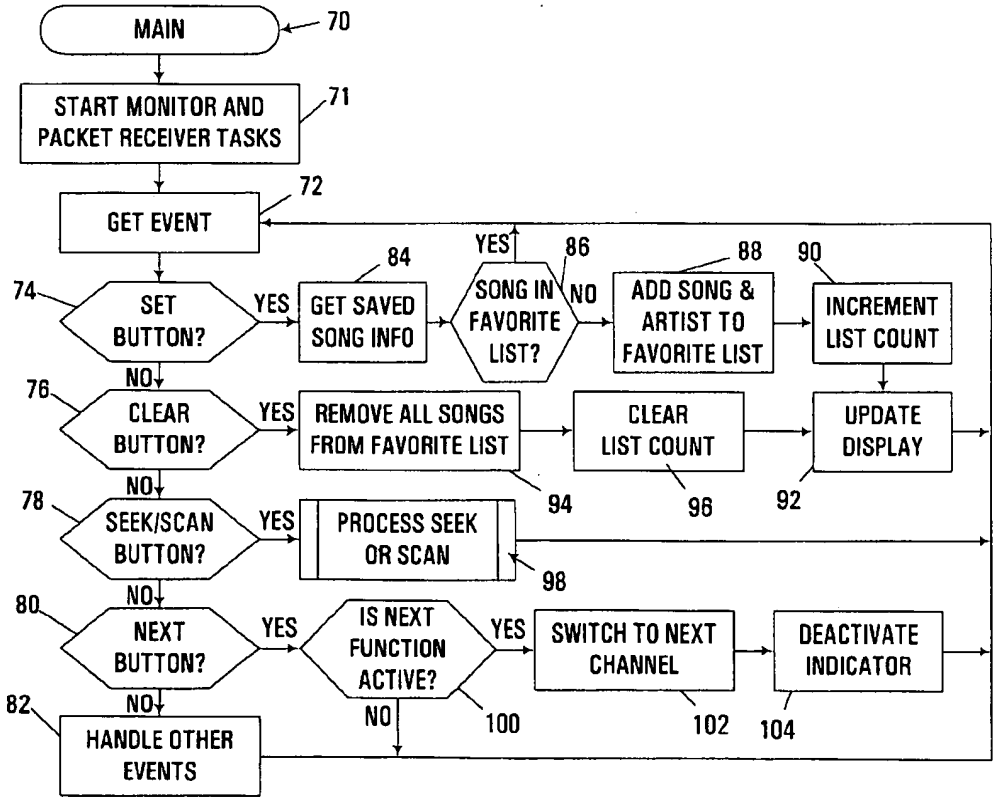
(57) **ABSTRACT**

An apparatus, program product, and method automate the selection of audio broadcast signals based upon a user preference criterion, typically by receiving a first audio broadcast signal from a first source, and concurrently monitoring a second source to locate a second audio broadcast signal matching a user preference criterion. The user preference criterion may represent a particular type of song, program, artist, genre, etc., or in the alternative may represent one or more specific programs, songs, etc. By monitoring for sources that match the user preference criterion concurrently with receiving a signal from a first source, automation of the selection of matching audio broadcast signals (e.g., by notifying a user of a match, automatically selecting a matching audio broadcast signal, etc.) is greatly facilitated.

29 Claims, 5 Drawing Sheets



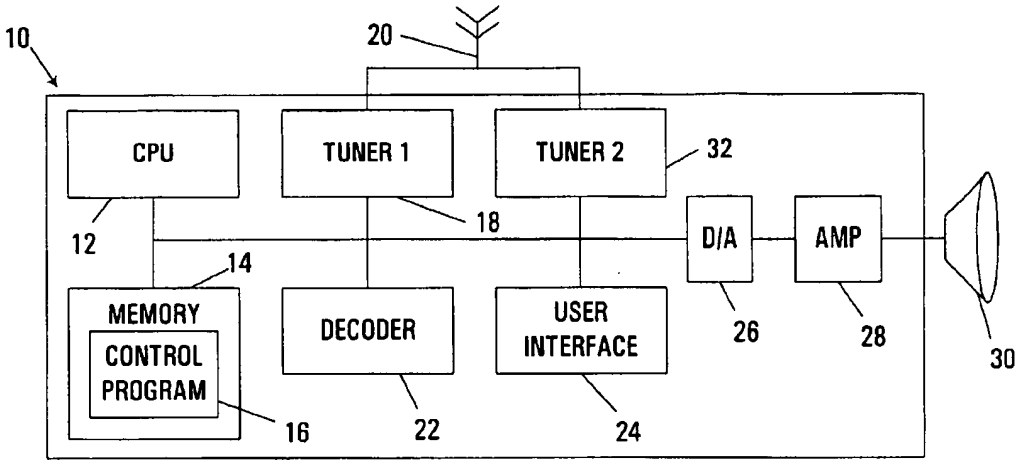

10
20
CPU
TUNER 1
TUNER 2
32
12
18
D/A
AMP
14
MEMORY
CONTROL PROGRAM
DECODER
USER INTERFACE
26
28
30
16
22
24

FIG. 1

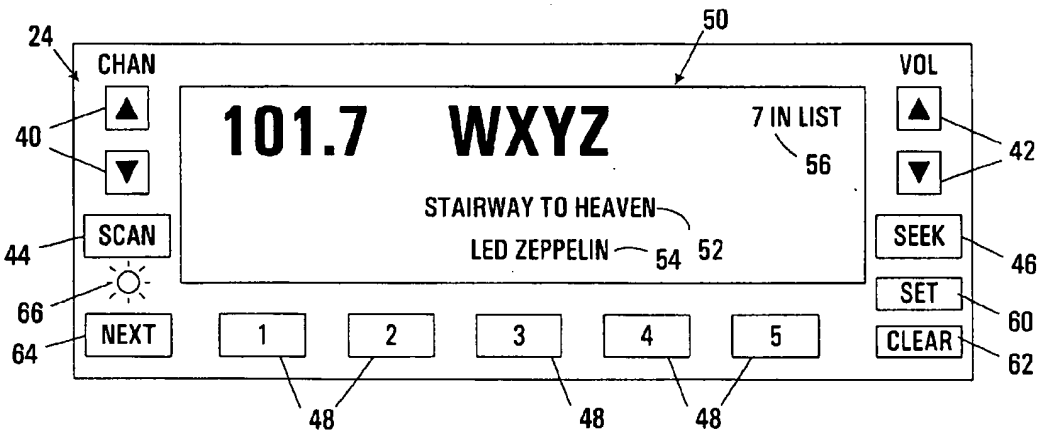

24
50
CHAN
VOL
101.7 WXYZ
7 IN LIST
56
40
42
STAIRWAY TO HEAVEN
LED ZEPPELIN
54
52
SCAN
44
SEEK
46
SET
66
60
NEXT
64
1
2
3
4
5
CLEAR
62
48
48
48

FIG. 2

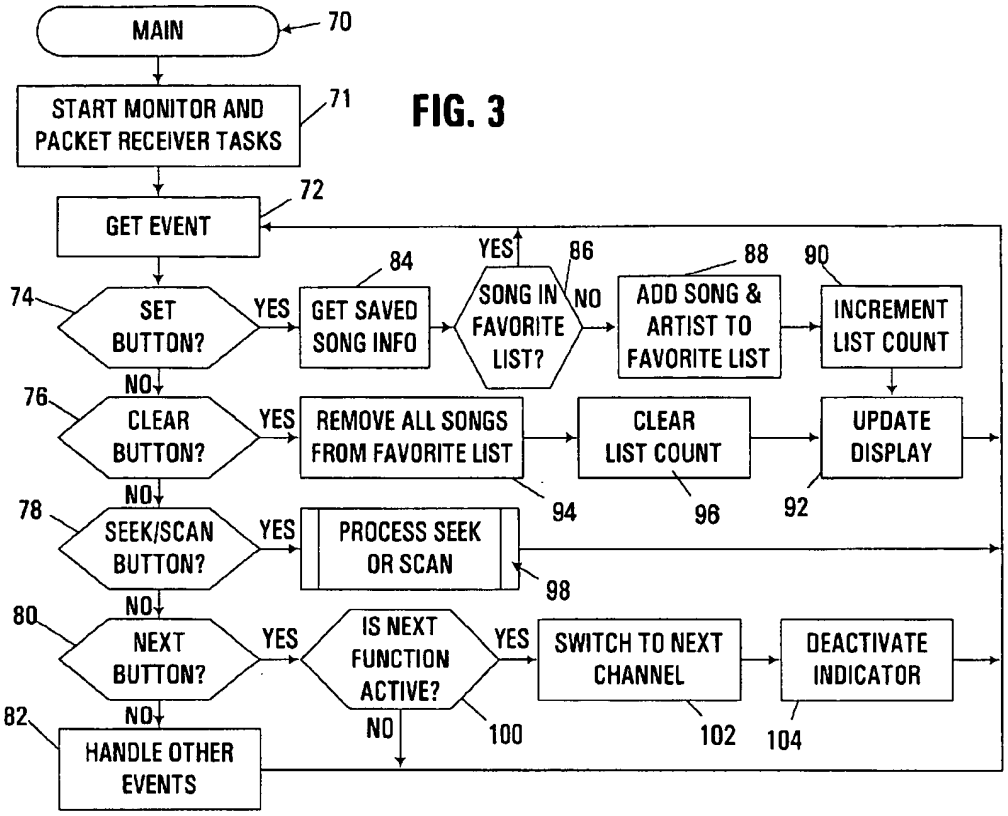

MAIN
70
START MONITOR AND PACKET RECEIVER TASKS
71
GET EVENT
72
SET BUTTON?
74
YES
GET SAVED SONG INFO
84
SONG IN FAVORITE LIST?
86
YES
NO
ADD SONG & ARTIST TO FAVORITE LIST
88
INCREMENT LIST COUNT
90
NO
CLEAR BUTTON?
76
YES
REMOVE ALL SONGS FROM FAVORITE LIST
94
CLEAR LIST COUNT
96
UPDATE DISPLAY
92
NO
SEEK/SCAN BUTTON?
78
YES
PROCESS SEEK OR SCAN
98
NO
NEXT BUTTON?
80
YES
IS NEXT FUNCTION ACTIVE?
100
YES
SWITCH TO NEXT CHANNEL
102
DEACTIVATE INDICATOR
104
NO
HANDLE OTHER EVENTS
82

FIG. 3

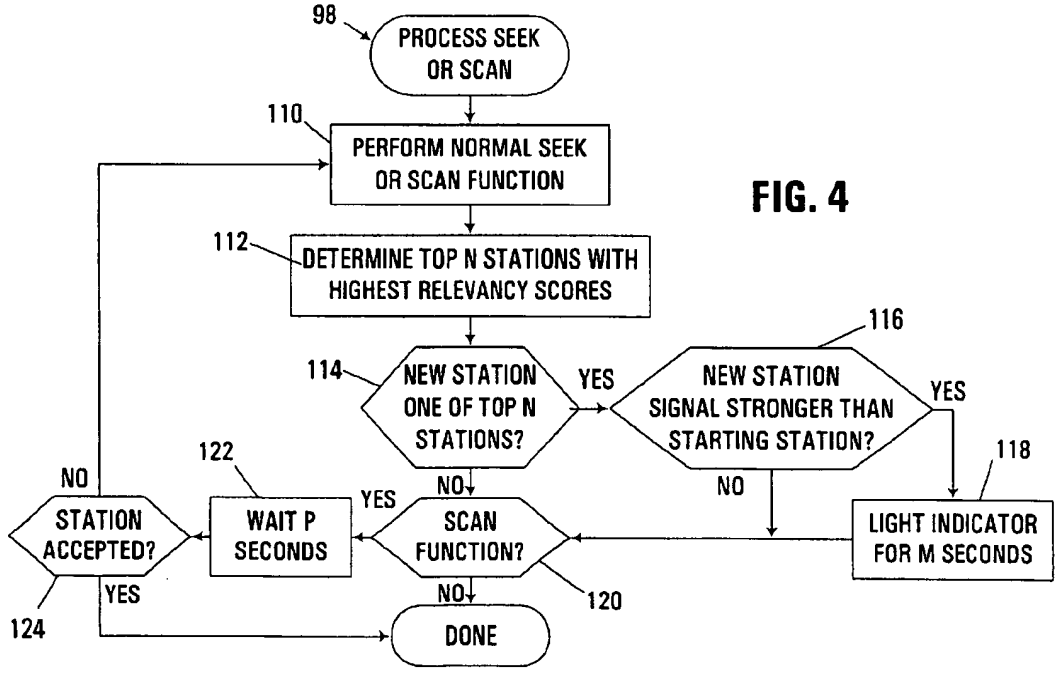

98
PROCESS SEEK OR SCAN
110
PERFORM NORMAL SEEK OR SCAN FUNCTION
112
DETERMINE TOP N STATIONS WITH HIGHEST RELEVANCY SCORES
114
NEW STATION ONE OF TOP N STATIONS?
YES
116
NEW STATION SIGNAL STRONGER THAN STARTING STATION?
YES
118
LIGHT INDICATOR FOR M SECONDS
NO
NO
122
WAIT P SECONDS
YES
SCAN FUNCTION?
120
NO
NO
STATION ACCEPTED?
124
YES
DONE

FIG. 4

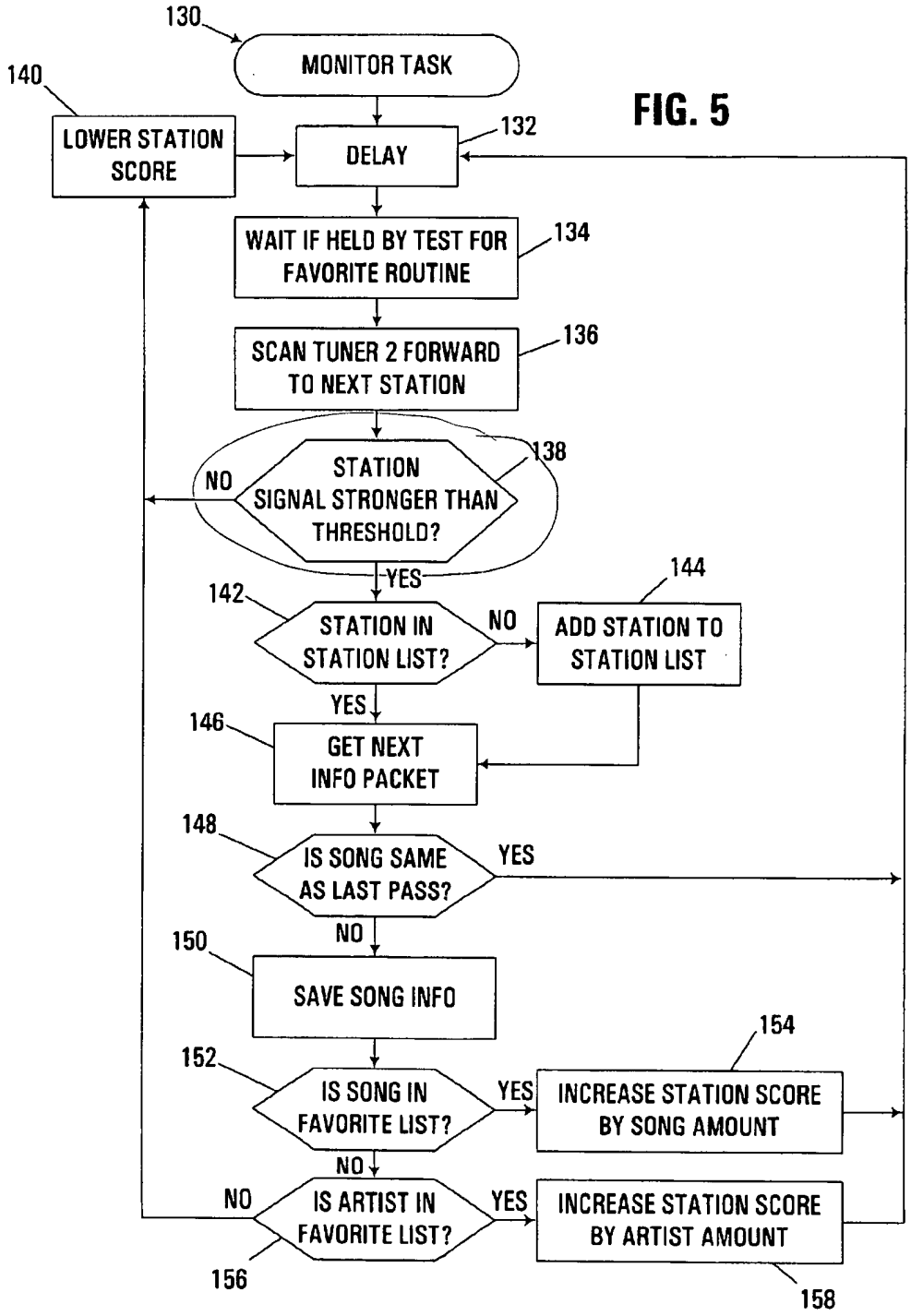

130
MONITOR TASK
140
LOWER STATION SCORE
DELAY
132
WAIT IF HELD BY TEST FOR FAVORITE ROUTINE
134
SCAN TUNER 2 FORWARD TO NEXT STATION
136
STATION SIGNAL STRONGER THAN THRESHOLD?
138
NO
YES
142
STATION IN STATION LIST?
NO
144
ADD STATION TO STATION LIST
YES
146
GET NEXT INFO PACKET
148
IS SONG SAME AS LAST PASS?
YES
NO
150
SAVE SONG INFO
152
IS SONG IN FAVORITE LIST?
YES
154
INCREASE STATION SCORE BY SONG AMOUNT
NO
NO
IS ARTIST IN FAVORITE LIST?
YES
INCREASE STATION SCORE BY ARTIST AMOUNT
156
158

FIG. 5

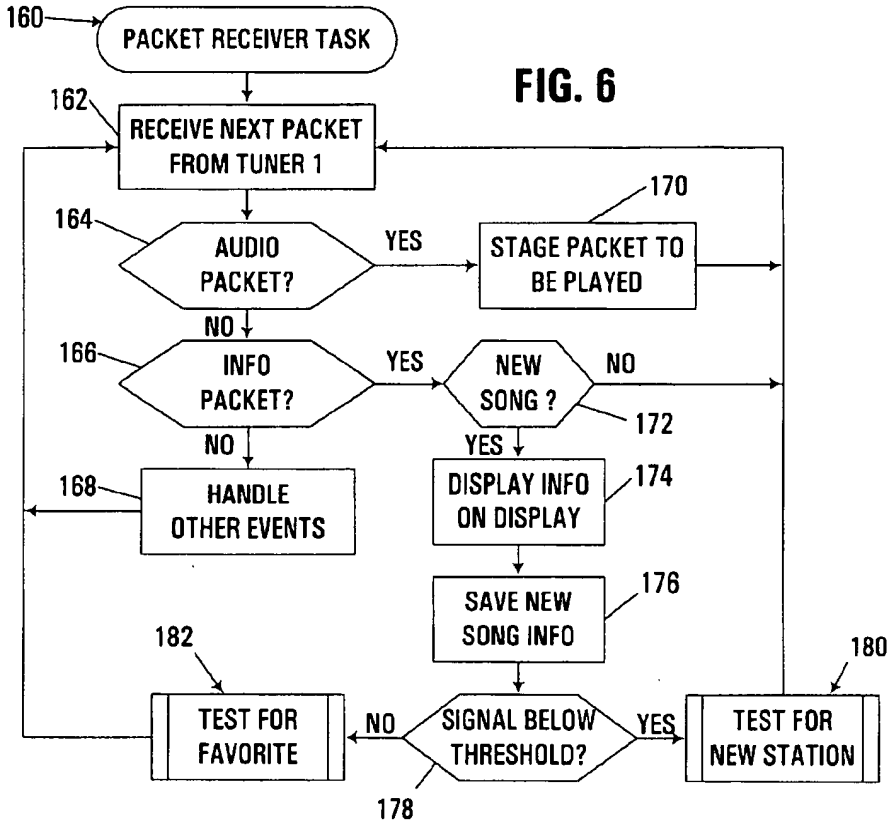

160
PACKET RECEIVER TASK
162
RECEIVE NEXT PACKET FROM TUNER 1
164
AUDIO PACKET?
YES
170
STAGE PACKET TO BE PLAYED
NO
166
INFO PACKET?
YES
NEW SONG ?
NO
172
NO
YES
168
HANDLE OTHER EVENTS
DISPLAY INFO ON DISPLAY
174
SAVE NEW SONG INFO
176
182
180
TEST FOR FAVORITE
NO
SIGNAL BELOW THRESHOLD?
YES
TEST FOR NEW STATION
178

FIG. 6

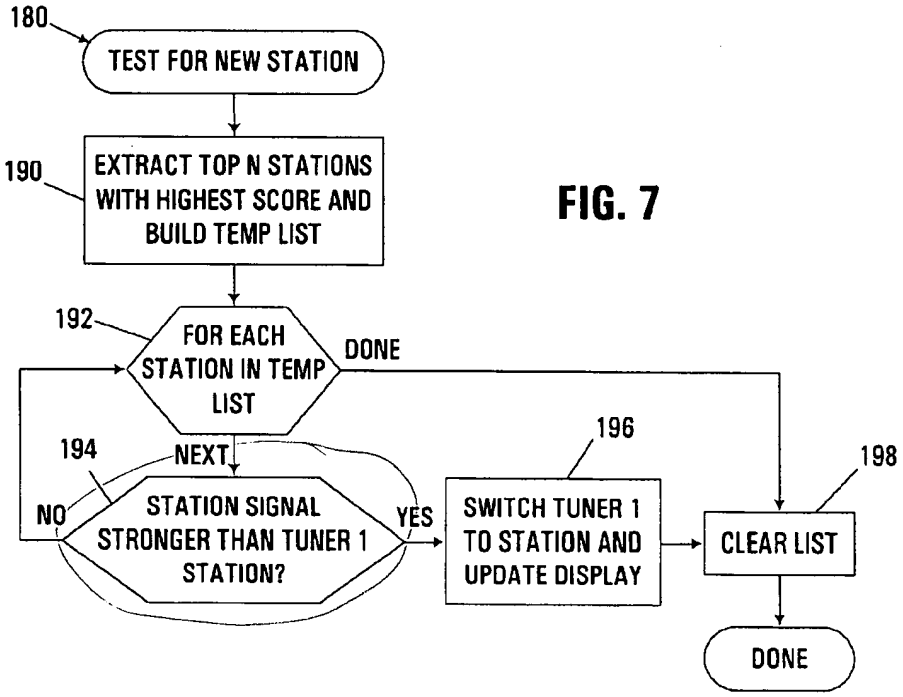

180
TEST FOR NEW STATION
190
EXTRACT TOP N STATIONS WITH HIGHEST SCORE AND BUILD TEMP LIST
192
FOR EACH STATION IN TEMP LIST
DONE
196
194
NEXT
198
NO
STATION SIGNAL STRONGER THAN TUNER 1 STATION?
YES
SWITCH TUNER 1 TO STATION AND UPDATE DISPLAY
CLEAR LIST
DONE

FIG. 7

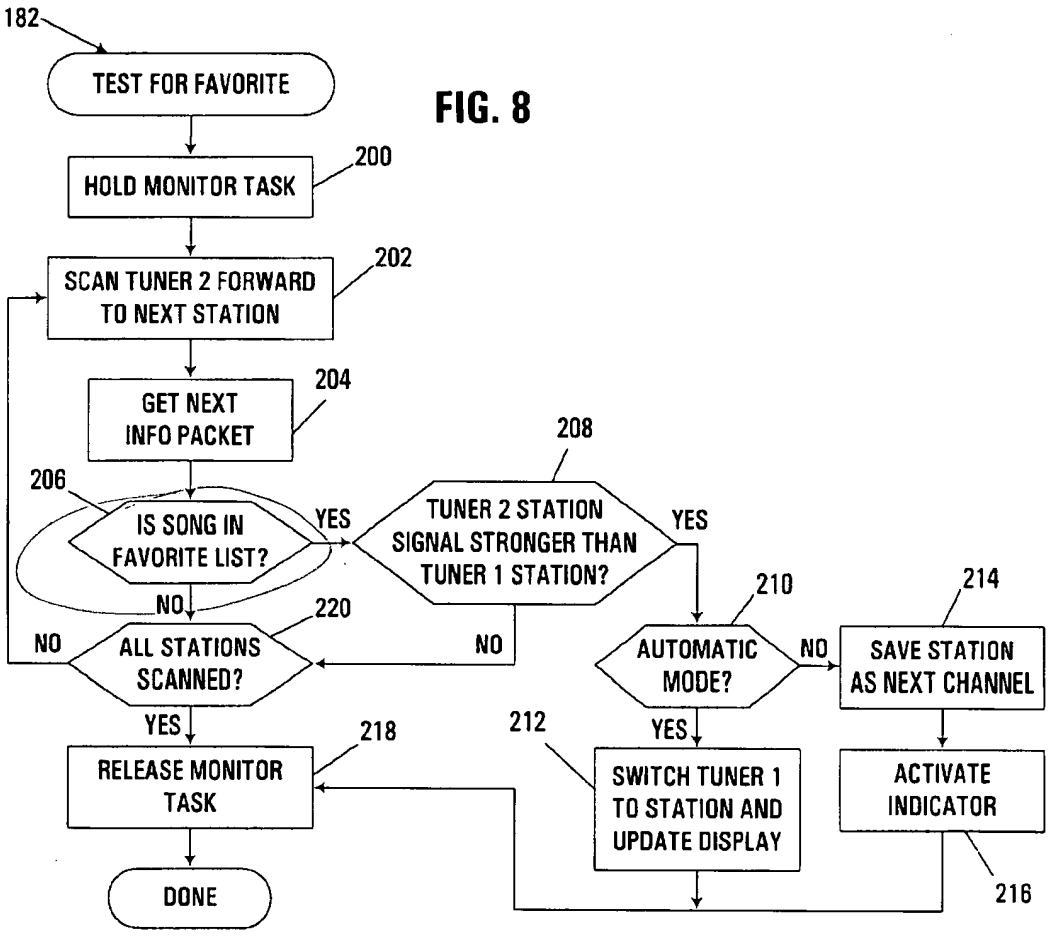

182
TEST FOR FAVORITE
HOLD MONITOR TASK
200
SCAN TUNER 2 FORWARD TO NEXT STATION
202
GET NEXT INFO PACKET
204
206
IS SONG IN FAVORITE LIST?
YES
NO
208
TUNER 2 STATION SIGNAL STRONGER THAN TUNER 1 STATION?
YES
NO
220
ALL STATIONS SCANNED?
NO
YES
210
AUTOMATIC MODE?
NO
YES
214
SAVE STATION AS NEXT CHANNEL
212
SWITCH TUNER 1 TO STATION AND UPDATE DISPLAY
ACTIVATE INDICATOR
216
218
RELEASE MONITOR TASK
DONE

FIG. 8

AUTOMATED SELECTION OF AUDIO BROADCAST SIGNAL SOURCE BASED ON USER PREFERENCE CRITERION

FIELD OF THE INVENTION

The invention is generally related to the transmission and reception of audio broadcasts, e.g., from radio stations and the like.

BACKGROUND OF THE INVENTION

Radio has been an important part of our culture for many years. Despite competition from relatively newer broadcast media such as television and the Internet, many people still find radio to be an important source of news, information, and entertainment. Radio has also significantly advanced since the days of analog AM and FM broadcasts. For example, radio broadcasts are now capable of being broadcast in a digital format, typically using a packet-based communication medium, and often providing better sound quality than with older analog technologies. Digital radio broadcasts are also capable of transmitting additional information to listeners, e.g., station call letters, program information, etc.

One continually strong market for radio stations has been listeners in automobiles, particularly due to the fact that visual information available from television and the Internet is not compatible with keeping one's eyes on the road. Mobile radio receivers commonly known as car radios or car stereos have long been provided as standard equipment in automobiles and other vehicles.

Mobile radio receivers have always suffered from the problem of varying signal strengths of audio broadcast signals such as radio broadcasts. Radio stations are capable of transmitting over only a certain geographical area, so the farther a receiver gets from a radio transmitter, the weaker the signal, and the poorer the reception by the receiver. Topographical factors such as buildings, tunnels, mountains, etc. can also affect signal strength. Thus, as a listener of a particular radio station rides along in an automobile, it is not uncommon for the reception of the audio broadcast signal to continually increase and decrease in quality.

Reception problems are often more problematic for travelers, as such listeners are constantly driving into and out of the reception areas for a wide variety of radio stations, the programming content of many if not all of which is unknown to such listeners. Consequently, as such listeners encounter poor reception of a radio station of interest, they are often required to manually scan through a radio band to attempt to locate other interesting radio broadcasts.

As one example, a listener may prefer a certain type of music, e.g., rock or country music. If a rock listener loses reception of a rock station, he or she will typically be forced to scan through other stations looking for other rock stations that are more likely to play songs that are interesting to the listener.

As another example, rather than being interested in a certain genre, a listener may be listening to a specific program such as a sporting event. Invariably, reception will become poor at a critical time in the event, e.g., in the last inning of a tight baseball game. Locating another station for the sporting event in such an instance is even more problematic than simply finding another station playing a general type of music, as the likelihood of finding the sporting event is lower, and time constraints necessitate the use of haste in locating the event as quickly as possible.

In addition to the inconvenience and frustration associated with manually searching through a radio band, any manual interaction with a radio receiver presents some safety concerns, as a listener is required to at least in part focus on interacting with the radio receiver rather than on paying attention to the road. Therefore, both convenience and safety would be well served by automating the selection of desirable audio content with a radio receiver.

SUMMARY OF THE INVENTION

The invention addresses these and other problems associated with the prior art by providing an apparatus, program product, and method that automate the selection of audio broadcast signals based upon a user preference criterion, typically by receiving a first audio broadcast signal from a first source, and concurrently monitoring a second source to locate a second audio broadcast signal matching a user preference criterion. The user preference criterion may represent a particular type of song, program, artist, genre, etc., or in the alternative may represent one or more specific programs, songs, etc. Thus, by monitoring for sources that match the user preference criterion concurrently with receiving a signal from a first source, automation of the selection of matching audio broadcast signals (e.g., by notifying a user of a match, automatically selecting a matching audio broadcast signal, etc.) is greatly facilitated.

These and other advantages and features, which characterize the invention, are set forth in the claims annexed hereto and forming a further part hereof. However, for a better understanding of the invention, and of the advantages and objectives attained through its use, reference should be made to the Drawings, and to the accompanying descriptive matter, in which there is described exemplary embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a digital radio receiver consistent with the invention.

FIG. **2** illustrates an exemplary display panel for the digital radio receiver of FIG. **1**.

FIG. **3** is a flowchart illustrating the program flow of a main routine executed by the digital radio receiver of FIG. **1**.

FIG. **4** is a flowchart illustrating the program flow of the process seek or scan routine referenced in FIG. **3**.

FIG. **5** is a flowchart illustrating the program flow of the monitor task referenced in FIG. **3**.

FIG. **6** is a flowchart illustrating the program flow of the packet receiver task referenced in FIG. **3**.

FIG. **7** is a flowchart illustrating the program flow of the test for new station routine referenced in FIG. **6**.

FIG. **8** is a flowchart illustrating the program flow of the test for favorite routine referenced in FIG. **6**.

DETAILED DESCRIPTION

The discussion hereinafter will focus on a specific implementation of the invention in the field of digital radio broadcasting, where an audio broadcast signal is transmitted in the form of a digital data stream incorporating streamed data packets carrying audio information representative of an audio broadcast. It is assumed for the purposes of the illustrated embodiments that program information, e.g., in the form of program information packets, is embedded within the digital data stream. However, it will be appreci-

ated by one of ordinary skill in the art having the benefit of the instant disclosure that certain aspects of the invention will have applicability in other applications where audio signals may be broadcasted, e.g., analog radio broadcasts, etc. Moreover, other manners of embedding program information within an audio broadcast signal may also be used in the alternative. Thus, the invention is not limited to the specific implementations discussed herein.

Turning now to the Drawings, wherein like numbers denote like parts throughout the several views, FIG. **1** illustrates a specific implementation of the invention in a digital radio receiver **10**, e.g., suitable for use in a mobile application (as with a car stereo) or a stationary application (as with a home stereo). Receiver **10** includes a central processing unit (CPU) **12** interfaced with a memory **14**, within which resides a control program **16** that is executed by the CPU to implement the functionality described herein, as well as other functionality of a digital radio receiver as is known in the art. In this context, CPU **12**, memory **14**, and control program **16** function as a controller for the digital radio receiver. In other environments, however, hardwired logic may be used in lieu of a stored program and processor, and thus, the invention is not limited to the particular implementation described herein.

Receiver **10** may be implemented using practically any type of computer, computer system or other programmable electronic device. The CPU **12** thereof may include one or more processors (e.g., microprocessors or microcontrollers), and the memory may represent volatile or non-volatile solid state memories, magnetic storage media, optical storage media, or combinations of the same, as well as any supplemental levels of memory, e.g., cache memories, backup memories (e.g., programmable or flash memories), read-only memories, etc. In addition, the memory may be considered to include memory storage physically located elsewhere in a digital processing system, e.g., any cache memory in a processor, as well as any storage capacity used as a virtual memory, e.g., as stored on a mass storage device or on another device coupled over a network interconnection.

Receiver **10** typically operates under the control of an operating system, and executes various computer software applications, components, programs, objects, modules, etc. (e.g., control program **16**, among others). Moreover, various applications, components, programs, objects, modules, etc. may also execute on one or more processors in another computer or other device coupled to such receiver via networked interconnections, e.g., in a distributed or client-server computing environment, whereby the processing required to implement the functions of a computer program may be allocated to multiple computers over a network.

In general, the routines executed to implement the embodiments of the invention, whether implemented as part of an operating system or a specific application, component, program, object, module or sequence of instructions will be referred to herein as "computer programs". The computer programs typically comprise instructions that are resident at various times in various memory and storage devices in a computer, and that, when read and executed by one or more processors in a computer, cause that computer to perform the steps necessary to execute steps or elements embodying the various aspects of the invention. Moreover, while the invention has and hereinafter will be described in the context of fully functioning computers and computer systems, those skilled in the art will appreciate that the various embodiments of the invention are capable of being distributed as a program product in a variety of forms, and that the invention applies equally regardless of the particular type of signal bearing media used to actually carry out the distribution. Examples of signal bearing media include but are not limited to recordable type media such as volatile and non-volatile memory devices, floppy and other removable disks, hard disk drives, optical disks (e.g., CD-ROM's, DVD's, etc.), among others, and transmission type media such as digital and analog communication links.

Over-the-air digital packets are received by a primary tuner **18** coupled to an antenna **20** and are decoded by a decoder **22**. Interaction with a user is supported via a user interface **24**, which may include both a display panel for displaying information to a user as well as one or more buttons for receiving input from a user. Audio data packets decoded by decoder **22** are converted into an analog format by a digital-to-analog (D/A) converter **26**, with the analog output of converter **26** fed to an amplifier **28** that drives one or more loudspeakers **30**. It will be appreciated that the reception and decoding of digital data packets, the generation and emission of an audible signal based upon the information within such packets, and the interaction with a user are all well understood functions implemented by digital radio receivers.

An additional broadcast reception device, e.g., a secondary tuner **32**, is utilized in receiver **10** to support the monitoring for alternate signal sources matching a user preference criterion while the user is listening to an audio broadcast signal received by tuner **18**. Tuner **32** may share antenna **20** with tuner **18**, or may utilize a separate antenna. Moreover, tuners **18** and **32** may be identically configured, or may differ from one another in terms of the bands received thereby (e.g., digital, AM, FM, etc.).

FIG. **2** illustrates an exemplary user interface **24**, e.g., as may be utilized in a mobile radio receiver for use in cars, trucks and other vehicles. User interface **24** is implemented specifically as a face plate control panel including a plurality of buttons **40–48** ad **60–64** for use in receiving user input and a display **50** capable of displaying information to a user. User interface **24** includes a number of conventional radio buttons, including tuning buttons **40**, volume buttons **42**, scan button **44**, seek button **46** and channel select buttons **48**, the use and configuration of which are well known in the art.

Display **50** may be implemented using any of a number of known display technologies, including, for example, LCD's, LED's, etc. Moreover, it will be appreciated that a wide variety of alternate user interfaces may be used in the alternative. For example, display **50** may incorporate a touch screen to permit direct user input to the display. In other applications, alternate computer or other electronic device interfaces may be used, including keyboards, pointing devices, video displays, etc., as appropriate for the particular type of application within which the receiver is being used. The invention is therefore not limited to the particular user interface disclosed herein.

Display **50** is typically configured to display program information to a user, e.g., a program or song title **52** and/or an artist **54**, as appropriate for the particular program information embedded within the audio broadcast signal received by tuner **18**. For example, FIG. **2** illustrates a representative song title and artist when a musical composition is being received by receiver **10**. In the alternative, if another type of program is being received, e.g., a sporting event, a news program, a talk show, etc., suitable identifying information may be displayed on display **50** as appropriate.

In addition to the aforementioned program information, display **50** may also display a song list count **56**, represent-

ing the number of songs stored in a favorites list representing the user preference criterion in the illustrated embodiment. As will become more apparent below, a user is able to create a favorites list containing favorite programs, songs and/or artists through selection of a set button **60** when a particular program or song is being received by tuner **18**. For example, if a user is currently listening to the song "Stairway to Heaven" by the artist Led Zeppelin, one or both of the song title and artist may be added to the favorites list in response to selection of set button **60**.

A complementary clear button **62** is used to clear the favorites list and eliminate past user selections. In one embodiment, using the clear button followed by the set button enables a user to select a single program to attempt to locate another source for the same program, e.g., to find a particular sporting event. In other embodiments, however, monitoring for a particular program may be supported separately from a favorites list such that prior user preferences need not be discarded whenever it is desirable to locate the particular program.

It will also be appreciated that other manners of storing and maintaining user preference information used in selecting other sources may be used consistent with the invention. For example, information pertaining to disliked programs, songs and/or artists may be used in lieu of or in addition to liked programs, songs and artists. In addition, no artist information may be tracked. Other alternatives will become apparent to one of ordinary skill in the art having the benefit of the instant disclosure.

An additional function supported by receiver **10** is a "next" function, which is supported to permit a user to select an alternate source that has been found to (1) be currently playing a program that matches the user preference criterion and (2) have a stronger signal than the current signal being received by tuner **18**. Activation of the next function is made via a next button **64**, and the availability of the next function, i.e., in response to a determination that an alternate source matching the above criterion has been found, is indicated by a visual indicator **66**.

FIG. **3** illustrates a main routine **70** executed by control program **16** of FIG. **1**. Routine **70** begins in block **71** by starting monitor and packet receiver tasks to perform various background functions for the receiver. In particular, the monitor task (described in connection with FIG. **5** below) monitors all available stations against the user preference criterion to determine the relevancy of such stations to the criterion. The packet receiver task (described in connection with FIGS. **6-8** below) primarily processes incoming packets from a digital radio broadcast data stream received by tuner **18** and decoded by decoder **22** (FIG. **1**).

Returning to FIG. **3**, control next passes to block **72** to initiate an event-driven loop to process events generated by the receiver. Received events are decoded by one of a plurality of blocks **74–82**. Blocks **74–80** specifically decode events utilized in implementing the automated monitoring and selection of signal sources consistent with the invention. Additional events processed by the main program, the details of which are not relevant to an understanding of the invention, are handled in a conventional manner in block **82**.

Block **74**, for example, detects depression of the set button, and in response passes control to block **84** to retrieve the saved song information, i.e., the program information for the current program being received by tuner **18**. Block **86** determines whether the song (or program) being listened to is already in the favorite list for the user. If so, control returns to block **72**. If not, however, control passes to block **88** to add both the song and the artist to the favorite list. Block **90** then increments the list count, representing the number of songs in the list. Control then passes to block **92** to update the display to reflect the new list count (e.g., as shown in FIG. **2**). Handling of the event is then complete.

Block **76** detects depression of the clear button, and in response passes control to block **94** to remove all songs from the favorite list. Block **96** then clears (nulls) the list count. Control then passes to block **92** to update the display to reflect the zero list count, and handling of the event is complete.

Block **78** detects depression of the seek or scan button, and in response calls a process seek or scan routine **98**, prior to returning control to block **72**. Routine **98** is discussed in greater detail below in connection with FIG. **4**.

Block **80** detects depression of the next button, and in response passes control to block **100** to determine whether the next function is active—that is, whether another source has been detected having a stronger signal and a current content that matches the user preference criterion (activation of the next function is discussed below in connection with FIG. **8**). If the function is not active, the button is disregarded, and control returns to block **72**. Otherwise, control passes to block **102** to switch to the "next" channel, and then to block **104** to deactivate the visual indicator **66** (FIG. **2**). Control then returns to block **72**.

FIG. **4** illustrates process seek or scan routine **98** in greater detail. Routine **98** begins in block **110** by performing a conventional seek or scan function—that is, to scan forward or backward through the current radio band to locate a station having a signal strength exceeding a minimum threshold. Control then passes to block **112** to determine the top N stations from a station list with the highest relevancy scores with respect to the current user selection criterion. As will be discussed in greater detail below, the aforementioned monitor task builds the station list that identifies all available stations, along with associated relevancy scores that indicate the relative degree to which each such stations matches the user preference criterion. As such, block **112** merely selects a subset of the station list ordered by relative relevancy.

Block **114** next determines whether the new station reached via the seek or scan function is in the subset of relevant stations. If so, control passes to block **116** to determine whether the signal strength of the new station is stronger than the station being received when the seek or scan function was activated. If so, control passes to block **118** to light the visual indicator for M seconds to indicate to the user that the new station is relevant based on the user preference criterion.

Control then passes to block **120** to determine whether the seek or scan button was depressed. If the seek button was depressed, routine **98** is complete, and the new station is selected. Otherwise, if the scan button was depressed, control passes to block **122** to wait P seconds to enable the user to listen to the new station, as well as to permit the user to reselect the scan button to indicate acceptance of the new station. As such, after the delay, control passes to block **124** to determine whether the user accepted the new station. If so, routine **98** is complete, and the new station is selected. Otherwise control returns to block **110** to scan to the next station having a signal strength exceeding the minimum threshold. In addition, returning to blocks **114** and **116**, if either the new station is not in the top N stations, or the new station signal strength does not exceed that of the starting station, block **118** is bypassed, and control proceeds directly to block **120**.

FIG. **5** illustrates a monitor task **130** in greater detail. Monitor task **130** is configured to periodically monitor all available stations to determine the relevancy of each station to the current user preference criterion. The task utilizes a list of available stations, each having a score associated therewith for representing the relevancy of the station to the current user preference criterion.

The monitor task begins in block **132** by waiting for a short delay. Next, block **134** determines whether the task is being held by a test for favorite routine (discussed below in connection with FIG. **8**). Holding the task permits the test for favorite routine to control the secondary tuner **32**, as will become more apparent below.

Once the task is released, control passes to block **136** to scan tuner **32** forward to the next available station. Typically, doing so incorporates scanning forward through the available frequencies to locate a next station having a signal strength that exceeds a minimum threshold, much like a seek or scan function.

Next, block **138** determines whether the station signal strength exceeds another, higher threshold used to determine whether the station is suitable for tracking as a potential favorite station. If not, a score for the station is lowered by passing control to block **140**. In addition, if the station score falls below a threshold, it may be desirable to remove the station from the list altogether.

If the signal strength exceeds the threshold, control passes to block **142** to determine whether the station is in the station list. If not, control passes to block **144** to add the station to the station list. After the station has been added, or if the station was already in the list, control passes to block **146** to obtain the next information packet from the digital data stream received by tuner **32**, containing the current program information for the station.

Block **148** next determines whether the current song (program) is the same as the last time the station was monitored. If so, control returns to block **132**, and monitoring of the current station is complete. If not, however, the current program information is saved for the station in block **150**. Next, block **152** determines whether the song (program) identified in the program information matches a song or program title in the favorite list. If so, control passes to block **154** to increase the station score by a song amount, thereby increasing the relevancy of the station. Control then returns to block **132**.

If the song is not in the favorite list, control passes to block **156** to determine if the artist identified in the program information is in the favorite list. If so, control passes to block **158** to increase the station score by an artist amount to increase the relevancy of the station on the list. Otherwise, control passes to block **140** to decrease the station score. It will therefore be seen that the monitor task is able to increase or decrease the score, or relevancy, of each station based upon both signal strength and relevancy to the user preference criterion. It will be appreciated that the relative values of the song amount, the artist amount and the amount that the station score is decreased in block **140** may be set to customize the response of the control program in determining the relative relevancy of the available stations.

FIG. **6** next illustrates a packet receiver task **160** in greater detail, which is principally utilized in handling the decoding and processing of packets received by decoder **22** from tuner **18**. Task **160** begins in block **162** by receiving a next packet from tuner **18**. Next, blocks **164–168** detect and decode different packet types. Block **164**, for example, detects audio packets, which represent the audio information that is converted to analog format and played back over speakers **30**. For each such packet, block **164** passes control to block **170** to stage the packet to be played back over the speakers, in a manner well known in the art.

Block **166** detects information packets, which are used to transmit program information, including, for example, station identification information, program or song title information, artist information, timing information, etc. Other types of packets may also be received; however, the details of such packets are not relevant to an understanding of the invention. Detection and handling of such packets in a conventional manner are therefore represented by block **168**.

Returning to block **166**, for each information packet, control passes to block **172** to determine whether a new song or program is being received. Typically, this is implemented by comparing the program information in the packet with saved song information for the current station. If the song has not changed, the packet is disregarded and control returns to block **162**. Otherwise; control passes to block **174** to display the new program information on the display.

Next, block **176** saves the new song (program) information for the current station, and control passes to block **178** to determine whether the current signal strength has fallen below a threshold. If so, a test for new station routine **180** is called by task **160**. If not, a test for favorite routine **182** is called by task **160**. Upon completion of either routine, control returns to block **162** to continue the processing of received packets.

FIG. **7** illustrates test for new station routine **180** in greater detail. Typically, routine **180** is called whenever the signal strength of the current station has fallen to a point that it is desirable to find another station that matches a user's preferences. As such, often the threshold used in block **178** of FIG. **6** is chosen based upon the likelihood that the current station is about to be, or has already been, lost.

Routine **180** begins in block **190** by extracting the top N stations from the station list having the highest relevancy scores, and placing the top N stations in a temporary list. In addition, the stations in the temporary list are typically sorted by relevancy score, with the highest score at the top of the list. Next, block **192** initiates a FOR loop to process each station in the temporary list. For each such station, control passes to block **194** to compare the signal strength of the station with the station currently being received by tuner **18**. The signal strength of the station from the temporary list may be determined, for example, by storing a signal strength during monitoring, switching tuner **18** to the station to determine a signal strength, or tuning tuner **32** to the station to determine a signal strength (which may require holding the monitor task).

If the signal strength is not greater than the current station, control returns to block **192** to process the next station in the temporary list. If the signal strength is greater, however, control passes to block **196** to switch tuner **18** to the new station and update the display information accordingly. Control then passes to block **198** to clear the temporary list, whereby routine **180** is complete. Returning to block **192**, if all stations in the temporary list are found to have signal strengths below the current station, control passes to block **198** to clear the list and terminate the routine without selecting a new station.

FIG. **8** illustrates test for favorite routine **182** in greater detail. Routine **182** is used to either automatically or semi-automatically select an alternate station whenever the current station signal exceeds the threshold in block **178** of FIG. **6**.

Routine **182** begins in block **200** by placing a hold on the monitor task, thereby freeing secondary tuner **32** for use by routine **182**. Next, block **202** scans tuner **32** forward to the next available station. Block **204** then retrieves the next information packet from the next station, and block **206** determines whether the song or program identified in the information packet is in the favorite list.

If so, control passes to block **208** to determine whether the signal strength of the next station received by tuner **32** exceeds that of the current station received by tuner **18**. If so, control passes to block **210** to select one of an automatic or a semiautomatic mode, typically based on user configuration of the receiver.

If an automatic mode is selected, control passes to block **212** to switch tuner **18** to the next station and update the display accordingly. Otherwise, if the semiautomatic mode is selected, control passes to block **214** to save the station as the "next" channel, and then to block **216** to activate the visual indicator. As such, in the semi-automatic mode the user is informed that another station is available for listening. Depression of the "next" button (discussed above in connection with FIG. **3**) will therefore initiate selection of the "next channel" station as the current station being received by tuner **18**.

Upon completion of either of block **212** or block **216**, control passes to block **218** to release the monitor task and terminate routine **182**. In addition, returning to blocks **206** and **208**, if either the current song is not on the favorite list, or the signal strength on tuner **32** does not exceed that of tuner **18**, control passes to block **220** to determine whether all stations have been scanned. If not, control returns to block **202** to scan forward to the next station. Otherwise, control passes to block **218** to release the monitor task and terminate the routine.

Various modifications may be made to the illustrated embodiments without departing from the spirit and scope of the invention. For example, various alternate data structures and selection criterion may be utilized to represent a user preference criterion consistent with the invention. Different relative relevancy weights may be assigned based on program, song, or artist, and furthermore, additional factors, e.g., an identified genre associated with a station (e.g., classic rock, country, talk radio, news, sports) may also be used in connection with song, artist and/or program information to determine a relevancy for a particular station.

In addition, other manners of selecting favorite songs, programs or artists may be used to generate a user preference criterion. For example, a database of favorite songs or artists may be searched by a user, with appropriate favorites selected by a user in lieu of or in addition to depression of a set button as described herein.

Furthermore, other manners of automating the selection of alternate stations may be used, whether or not based on the signal strength of the current station. For example, a user may be notified whenever another station is currently playing a song or program on the favorite list despite the signal strength of the current station. The user may then be prompted to select the new station, and may be informed of the title of the song and/or the identity of the new station to assist the user in deciding whether to select the new station. If multiple stations are playing songs from a favorite list, the user may even be presented with a list of such stations and/or songs (e.g., via a scrollable menu on the display).

Other modifications will be apparent to one of ordinary skill in the art. Therefore, the invention lies in the claims hereinafter appended.

What is claimed:

1. A method of receiving audio broadcasts, the method comprising:

(a) receiving a first audio broadcast signal from a first source;

(b) monitoring a second source concurrently with receiving the audio broadcast signal from the first source to locate a second audio broadcast signal matching a user preference criterion, wherein monitoring the second source includes receiving program information in the second audio broadcast signal; and

(c) comparing the program information with the user preference criterion, wherein the program identification identifies a program title, and wherein the user preference criterion identifies at least one favorite program, wherein comparing the program information with the user preference criterion includes comparing the program title from the second audio broadcast signal with the favorite program identified by the user preference criterion.

2. The method of claim **1**, wherein receiving the first audio broadcast signal is performed with a first tuner, and monitoring the second source is performed with a second tuner.

3. The method of claim **2**, wherein the first and second tuners are configured to receive digital radio signals.

4. The method of claim **1**, wherein monitoring the second source includes scanning through a plurality of sources to locate audio broadcast signals that match the user preference criterion.

5. The method of claim **1**, further comprising notifying a user that the second audio broadcast signal matches the user preference criterion.

6. The method of claim **1**, further comprising selecting the second audio broadcast signal to be received in lieu of the first audio broadcast signal responsive to the second audio broadcast signal matching the user preference criterion.

7. The method of claim **1**, wherein selecting the second audio broadcast signal is further responsive to a signal strength of the second audio broadcast signal exceeding that of the first audio broadcast signal.

8. A method of receiving audio broadcasts, the method comprising:

(a) receiving a first audio broadcast signal from a first source:

(b) monitoring a second source concurrently with receiving the audio broadcast signal from the first source to locate a second audio broadcast signal matching a user preference criterion, wherein monitoring the second source includes receiving program information in the second audio broadcast signal; and

(c) comparing the program information with the user preference criterion, wherein the program information identifies a song title, and wherein the user preference criterion identifies at least one favorite song, wherein comparing the program information with the user preference criterion includes comparing the song title from the second audio broadcast signal with the favorite song identified by the user preference criterion.

9. The method of claim **8**, wherein the program information further identifies an artist, and wherein the user preference criterion identifies at least one favorite artist, wherein comparing the program information with the user preference criterion further includes comparing the artist from the second audio broadcast signal with the favorite artist identified by the user preference criterion.

10. The method of claim 9, wherein the user preference criterion identifies a plurality of favorite songs and a plurality of favorite artists.

11. The method of claim 10, further comprising adding at least one of a song and an artist identified by program information in the first audio broadcast signal to the user preference criterion in response to user input received during reception of the first audio broadcast signal.

12. A method of receiving audio broadcasts, the method comprising:

(a) receiving a first audio broadcast signal from a first source;

(b) monitoring a second source concurrently with receiving the audio broadcast signal from the first source to locate a second audio broadcast signal matching a user preference criterion, wherein monitoring the second source includes scanning through a plurality of sources to locate audio broadcast signals that match the user preference criterion; and

(c) calculating a relevancy score for at least a subset of sources from the plurality of sources based upon the relevancy of each source in the subset of sources to the user preference criterion.

13. The method of claim 12, further comprising:

(a) detecting a signal strength for the first audio broadcast signal being below a threshold; and

(b) in response thereto, using the relevancy scores of the subset of sources to select an alternate source from which to receive an alternate audio broadcast signal in lieu of the first audio broadcast signal.

14. A method of receiving audio broadcasts, the method comprising:

(a) receiving a first audio broadcast signal from a first source, including receiving program information in the first audio broadcast signal that identifies a current program;

(b) monitoring program information from a plurality of sources concurrently with receiving the audio broadcast signal from the first source to locate an alternate source for the current program;

(c) indicating that an alternate source for the current program is available with a stronger signal than the first source; and

(d) switching from the first source to the alternate source with the stronger signal in response to user input.

15. The method of claim 14, wherein receiving the first audio broadcast signal is performed with a first digital radio tuner, and wherein monitoring program information from a plurality of sources is performed with a second digital radio tuner.

16. The method of claim 15, wherein switching from the first source to the alternate source comprises returning the first digital radio tuner to receive a second audio broadcast signal from the alternate source for the current program.

17. A method of receiving audio broadcasts, the method comprising:

(a) receiving user input defining a user preference criterion that identifies user preferences for audio broadcast programming;

(b) monitoring program information from a plurality of sources to locate at least one source matching the user preference criterion wherein the user preference criterion identifies at least one of a favorite program, a favorite song and a favorite artist, and wherein monitoring the program information includes comparing the program information with the user preference criterion by comparing at least one of the program title, the song title and the artist from the second audio broadcast signal with at least one of the favorite program, the favorite song and the favorite artist identified by the user preference criterion; and

(c) indicating during reception of an audio broadcast signal from a first source whether the first source matches the user preference criterion.

18. An apparatus, comprising:

(a) a tuner configured to receive a first audio broadcast signal from a first source; and

(b) a program configured to monitor a second source concurrently with reception of the audio broadcast signal from the first source to locate a second audio broadcast signal matching a user preference criterion, wherein the program is configured to monitor the second source by receiving program information in the second audio broadcast signal, and to compare the program information with the user preference criterion;

wherein the program identification identifies at least one of a program title, a song title and an artist, and wherein the user preference criterion identifies at least one of a favorite program, a favorite song and a favorite artist, and wherein the program is configured to compare the program information with the user preference criterion by comparing at least one of the program title, the song title and the artist from the second audio broadcast signal with at least one of the favorite program, the favorite song and the favorite artist identified by the user preference criterion.

19. The apparatus of claim 18, further comprising a second tuner, wherein the program is configured to monitor the second source using the second tuner.

20. The apparatus of claim 18, wherein the program is configured to monitor the second source by scanning through a plurality of sources to locate audio broadcast signals that match the user preference criterion.

21. The apparatus of claim 18, wherein the program is further configured to add at least one of a song and an artist identified by program information in the, first audio broadcast signal to the user preference criterion in response to user input received during reception of the first audio broadcast signal.

22. The apparatus of claim 18, wherein the program is further configured to calculate a relevancy score for at least a subset of sources from the plurality of sources based upon the relevancy of each source in the subset of sources to the user preference criterion, detect a signal strength for the first audio broadcast signal being below a threshold; and, in response thereto, to use the relevancy scores of the subset of sources to tune the tuner to receive an alternate audio broadcast signal in lieu of the first audio broadcast signal.

23. The apparatus of claim 18, wherein the program is further configured to notify a user that the second audio broadcast signal matches the user preference criterion.

24. The apparatus of claim 18, wherein the program is further configured to tune the tuner to receive the second audio broadcast signal in lieu of the first audio broadcast signal responsive to the second audio broadcast signal matching the user preference criterion.

25. The apparatus of claim 18, wherein the program is further configured to tune the tuner to receive the second audio broadcast signal further responsive to a signal strength of the second audio broadcast signal exceeding that of the first audio broadcast signal.

26. An apparatus, comprising:

(a) a tuner configured to receive a first audio broadcast signal from a first source, the first audio broadcast signal including program information that identifies a current program;

(b) a program configured to monitor program information from a plurality of sources concurrently with reception of the audio broadcast signal from the first source to locate an alternate source for the current program, to indicate that an alternate source for the current program is available with a stronger signal than the first source, and to switch from the first source to the alternate source with the stronger signal in response to user input.

27. An apparatus, comprising:

(a) a tuner configured to receive a first audio broadcast signal from a first source; and

(b) a program configured to receive user input defining a user preference criterion that identifies user preferences for audio broadcast programming, to monitor program information from a plurality of sources to locate at least one source matching the user preference criterion, and to indicate during reception of the first audio broadcast signal from the first source whether the first source matches the user preference criterion, wherein the user preference criterion identifies at least one of a favorite program a favorite song and a favorite artist, and wherein the program is configured to compare the program information with the user preference criterion by comparing at least one of the program title, the song title and the artist from the second audio broadcast signal with, at least one of the favorite program, the favorite song and the favorite artist identified by the user preference criterion.

28. A program product, comprising:

(a) a program configured to receive a first audio broadcast signal from a first source, and to monitor a second source concurrently with reception of the audio broadcast signal from the first source to locate a second audio broadcast signal matching a user preference criterion wherein the program is configured to monitor the second source by receiving program information in the second audio broadcast signal and to compare the progarm information with the user preference criterion, wherein the program identification identifies at least one of a program title, a song title and an artist, and wherein the user preference criterion identifies at least one of a favorite program, a favorite song and a favorite artist, and wherein the program is configured to compare the program information with the user preference criterion by comparing at least one of the program title, the song title and the artist from the second audio broadcast signal with at least one of the favorite program, the favorite song and the favorite artist identified by the user preference criterion; and

(b) a signal bearing medium bearing the program.

29. The program product of claim 28, wherein the signal bearing medium includes at least one of a recordable medium and a transmission medium.

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